

1999 Fuel Cells GRC Army Research Office Grant No. DAAD19-99-1-0271

Abstract Report

The first GRC on Fuel Cells originated from interest expressed jointly by industry, national laboratories and academia. While there are many meetings organized by interested parties and/or for profit sponsors, a critical, impartial forum for open discussion was lacking. The subject has spread in the last few years with ever increasing rapidity. As of now several of the biggest industrial corporations and research institutions all over the globe have begun or augmented research efforts on the subject. Also, with the express support from Government granting agencies interested in furthering the subject, research funds have spurred a large body of academic work. The intent was to gather under one umbrella in a focused manner researchers from different fields whose work is very relevant to the subject matter. The multifarious topics covered the gamut from the very fundamental to the practical with presentations by the foremost authorities in Fuel Cells science and technology. All the presentations were followed by spirited discussions. The GRC management has approved yearly continuation of the Fuel Cell Conferences.

Appendix

The Co-Chairs were **Shimshon Gottesfeld**, Los Alamos Natl. Lab. And **Mordecai Shelef**, Ford Scientific Research Laboratory.

The topics presented included:

J. Turner, NREL, US, Hydrogen Production from Water and Sunlight via Photoelectrolysis; **E. Greenbaum**, ORNL, US, Renewable Hydrogen and Oxygen Production by Photosynthetic Water Splitting; **P. N. Ross**, LBNL, US, The Skin-Effect in the Electrocatalytic Properties of Certain Binary Alloys; **S. Mukherjee**, Northeastern Univ., US, Electrocatalysis at Nano-Phase Cluster Interfaces: A Molecular Level Perspective; **M. Watanabe**, Yamanashi University, Japan, Design and catalysis mechanisms of Pt alloy catalysts for CO tolerant anodes and high performance cathodes in PEFC's; **A. Wieckowski**, University of Illinois, US, Platinum/Ruthenium Methanol Oxidation Electrocatalysis: Structure/Function Relationships; **K. Colbow**, Ballard, Canada, In-Situ Characterization of Direct Methanol Fuel Cells and Stacks under Practical Operating Conditions; **K-D. Kreuer**, Max Planck Institute, Stuttgart, Germany, On the Way to New Membrane Materials for Hydrogen and Methanol FC's; **M. Pineri**, France, Sulfonated polyimide membranes for polymer electrolyte fuel cells; **P. Pintauro**, Tulane University, US, Polyphosphazene-Based Proton-Exchange Membranes for Direct Methanol Fuel Cells; **T. Zawodzinski**, Los Alamos National Laboratory, US, The Membrane/Electrode Assembly and "Practical Electrocatalysis" in the Fuel Cell; **W. Schnurnberger**, DLR, Germany, Current Distribution and Transient Response in PEFC Stacks; **W. Worrell**, U. Penn., US, Current Trends in Planar SOFC Research and Development; **S. Singhal**, Siemens- Westinghouse, US, Recent Progress in Solid Oxide Fuel Cells; **U. Stimming**, Technical University Munich, Germany, Concepts of SOFC co-generation power plants for the kW to MW range;

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Richard Bellow/Paul Berlowitz, Exxon, US, Hydrocarbon Fuel Processors - Development Issues in Fuel Cell Vehicle Applications; **H. Gasteiger**, Opel, Germany Selective Oxidation of CO in H₂-Rich Gas: Mechanistic Aspects and Process Optimization; **Manfred Waidhas**, Siemens, Germany, PEM Fuel Cells for Mobile and Decentralized Applications - System and Component Aspects; **Romesh Kumar**, ANL, US, Design Considerations for a Gasoline-Fueled Automotive Fuel Cell System; **R.M. Moore**, UC Davis, US, Comparative Evaluation of Fuel Cell Power Systems for Transportation.

Gordon Research Conference on

Fuel Cells

Plymouth State College
Plymouth, New Hampshire, USA
June 27-July 2, 1999

Co-Chairs

Shimshon Gottesfeld (*Los Alamos National Lab*)
Mordecai Shelef (*Ford Scientific Research Laboratory*)

Fuel cells is an area of scientific research that presently merits a Gordon Conference unto itself. This research is related to challenging scientific problems in areas of materials science, interfacial science, transport phenomena, electrocatalysis and heterogeneous catalysis. Subjects at the frontier of the field are:

- preparation of multilayered thin film structures with effective interfacial characteristics
- heterogeneous catalysis at low temperature under adverse conditions of severe surface contamination
- subtle effects of metal particle size and metal crystal structure on electrocatalysis in the nanometer range of particle sizes
- heterogeneous catalysis in non-steady state systems for the reforming of liquid fuels to hydrogen
- transport phenomena in complex materials including ion conducting membranes and porous layers of mixed hydrophilic/hydrophobic surface characteristics
- water interaction with polymeric surfaces, and more.

The relevance is almost self evident. The subject has spread in the last few years with ever increasing rapidity. As of now several of the biggest industrial corporations and research institutions all over the globe have begun or augmented research efforts on the subject. Among these are the American, German, Japanese and other automotive companies (GM, Ford, Chrysler, Toyota, Daimler Benz, BMW, Mazda, Fiat and several others); energy companies (Mobil, Amoco, Shell); equipment companies (Siemens, ABB, Alstom, United Technologies, Westinghouse, Ballard); government laboratories (Los Alamos, Lawrence Berkeley, Argonne), contract laboratories (SRI, ADL). With the support from Government granting agencies (DOE, DARPA, NSF) interested in furthering the subject, research funds have spurred academic work. It is a conference that will contribute to reversing the prevailing trend of decreasing participation of industrial scientists in GCR.

Sunday Night: Fuel Generation from Renewable Resources

Session Chair: **Ross Lemons**, *LANL*

- **J. Turner**, *NREL, US*
Hydrogen Production from Water and Sunlight via Photoelectrolysis

- **E. Greenbaum, ORNL, US**
Renewable Hydrogen and Oxygen Production by Photosynthetic Water Splitting

Monday Morning: Electrocatalysis

Session Chair: **Eric Stuve, Univ. of Washington**

- **P. N. Ross, LBNL, US**
The Skin-Effect in the Electrocatalytic Properties of Certain Binary Alloys
- **S. Mukherjee, Northeastern Univ., US**
Electrocatalysis at Nano-Phase Cluster Interfaces: A Molecular Level Perspective
- **M. Watanabe, Yamanashi University, Japan**
Design and catalysis mechanisms of Pt alloy catalysts for CO tolerant anodes and high performance cathodes in PEFCs

Monday Night : Electrocatalysis & Direct Methanol Fuel Cells

Session Chair: **S.R. Narayanan, JPL**

- **A. Wieckowski, Urbana, US**
Platinum/Ruthenium Methanol Oxidation Electrocatalysis: Structure/Function Relationships
- **K. Colbow, Ballard**
In-Situ Characterization of Direct Methanol Fuel Cells and Stacks under Practical Operating Conditions

Tuesday Morning: The Ionomeric Membrane

Session Chair: **Robert Savinell, Case Western Reserve Univ.**

- **K-D. Kreuer, Max Planck Institute, Stuttgart, Germany**
On the Way to New Membrane Materials for Hydrogen and Methanol FCs
- **M. Pineri, France**
Sulfonated polyimide membranes for polymer electrolyte fuel cells
- **P. Pintauro, Tulane University, US**
Polyphosphazene-Based Proton-Exchange Membranes for Direct Methanol Fuel Cells

Tuesday Night: Membrane/electrode Assemblies & Cells

Chair: **Don Maricle, Maricle Consulting, US**

- **T. Zawodzinski, Los Alamos National Laboratory, US**
The Membrane/Electrode Assembly and "Practical Electrocatalysis" in the Fuel Cell
- **W. Schnurnberger, DLR, Germany**
Current Distribution and Transient Response in PEFC Stacks

Wednesday Morning: Solid Oxide Fuel Cells

Chair: **Scott Barnett, Northwestern Univ.**

- **W. Worrell, U. Penn., US**
Current Trends in Planar SOFC Research and Development
- **S. Singhal, Siemens-Westinghouse, US**
Recent Progress in Solid Oxide Fuel Cells
- **U. Stimming, Technical University Munich, Germany**
Concepts of SOFC co-generation power plants for the kW to MW range

Wednesday Night: Fuel Processing: Liquid Fuels to Hydrogen

Chair: **Wayne Goodman**, *Texas A & M Univ.*

- **Richard Bellow/Paul Berlowitz**, *Exxon*
Hydrocarbon Fuel Processors - Development Issues in Fuel Cell Vehicle Applications
- **H. Gasteiger**, *Opel, Germany*
Selective Oxidation of CO in H₂-Rich Gas: Mechanistic Aspects and Process Optimization

Thursday Morning : The Fuel Cell Stack and Power System

Chair: **Jim Adams**, *Ford Motor Company*

- **Manfred Waidhas**, *Siemens, Germany*
PEM Fuel Cells for Mobile and Decentralized Applications - System and Component Aspects
- **Romesh Kumar**, *ANL*
Design Considerations for a Gasoline-Fueled Automotive Fuel Cell System
- **R.M. Moore**, *UC Davis, CA*
Comparative Evaluation of Fuel Cell Power Systems for Transportation

Thursday Night: Plenary Lecture and General Discussion

- **Paul MacCready**, *AeroVironment, CA, US*



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FUEL CELLS

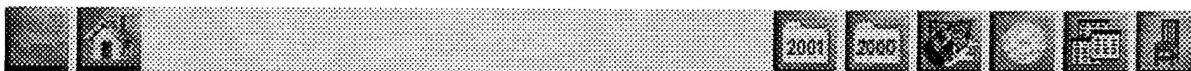
Plymouth State College, Plymouth, NH
(27-Jun-99) - (02-Jul-99)

This was the final registration list for the 1999 Conference on
FUEL CELLS.

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